MOUNTAIN STATION
Central Reference File
No. 0.73
FOREST SERVICE
RECEIVED
JAN 23 1936
RESEARCH
INTERMOUNTAIN

FOURTEENTH ANNUAL REPORT AND PROGRAM

APPALACHIAN FOREST EXPERIMENT STATION

1934 - 1935

FOURTEENTH ANNUAL REPORT AND PROGRAM

APPALACHIAN FOREST EXPERIMENT STATION

1934 - 1935

Station Headquarters - Federal Building, Asheville, N. C.

Branch Stations and Experimental Forests

Bent Creek - Pisgah National Forest, Asheville, N. C.

Coweeta - Nantahala National Forest, Franklin, N. C.

Fernow - Monongahela National Forest, Parsons, W. Va.

Toccoa - Cherokee National Forest, Blairsville, Ga.

Cooperating Experimental Forests

Berea College Forest - Berea, Kentucky.

Georgia Mountain Experiment Station Forest, Blairsville, Ga.

C O N T E N T S

APPALACHIAN FOREST EXPERIMENT STATION

PERSONNEL

C. L. Forsling	Director
E. H. Frothingham	Senior Silviculturist
C. R. Hursh	Forest Ecologist
R. M. Nelson	Silviculturist
L. I. Barrett	Silviculturist
J. H. Buell	Assistant Silviculturist
A. L. MacKinney	Assistant Silviculturist
C. A. Abell	Assistant Silviculturist
Margaret S. Abell	Junior Forester
Josephine Laxton	Chief Clerk
Grace M. Foltz	Senior Clerk
Mary P. Cudger	Stenographer

Emergency Employees

Assistant Forester.

Beeman, Robert M.	Loughead, Harvey J.
Besley, Lowell	Maughan, Wm.
Chaiken, Leon R.	Plice, M. J.
Dubuar, James F.	Robinson, T. M.
Hicks, Vernon E.	Snow, A. G.

Junior Forester

Anderson, Geo. R.	Mandeville, Albert
Bershinger, Geo. R.	Morgan, Kenneth, J.
Boutwell, Samuel, A.	Peters, Geo. J.
Doerrie, Fred	Renshaw, James, F.

Assistants to Technician

Bibler, Gilbert, S.	Huskin, D. C.
Bjorkman, Edwin	Jacot, Arthur
Brater, Ernest, F.	Koulichkov, Serge
Crafton, W. M.	McCartney, David, C.
Creasman, Hugh, C.	McDowell, Wm. S.
Creasman, W. O.	Nesbitt, W. A.
Fleming, Burtt	Riley, M. M.
Fuller, W. B.	Rogers, Ed, L.
Hertzler, Richard, A.	Schneider, Carl, E.

Clerical

Armstrong, Mary	Patterson, Ruth
Browning, Katherine	Shelton, James. H.
Curtis, Evelyn	

BIOLOGICAL SURVEY

Thos. D. Burleigh (Transferred to Southern For. Exp. Sta. May 1935)	Associate Biologist

BUREAU OF ENTOMOLOGY & PLANT QUARANTINE

R. A. St. George	Entomologist
B. H. Wilford	Junior Entomologist
H. R. Johnston	Junior Entomologist
C. B. Eaton	Under Scientific Helper

BUREAU OF PLANT INDUSTRY

George H. Hepting	Assistant Pathologist
M. L. Lohman	Technician
J. D. Diller	Technician
F. G. Liming	Technician
E. R. Roth	Technician
Luther Shaw	Technician

FOREST FIRE WEATHER

L. T. Pierce	Assistant Meteorologist

APPALACHIAN FOREST RESEARCH COUNCIL

W. D. Tyler, President
J. H. Pratt, Chairman of Executive Committee

Georgia

T. G. Woolford, Retail Credit Company, Atlanta

Kentucky

T. P. Cooper, Director, Kentucky Agr. Experiment Sta., Lexington
W. J. Hutchins, President, Berea College, Berea

North Carolina

G. A. Cardwell, Atlantic Coast Line Railway, Wilmington
Andrew Gennett, President, Gennett Lumber Company, Asheville
J. S. Holmes, State Forester, Raleigh
J. H. Pratt, Consulting Engineer, Chapel Hill
Verne Rhoades, Consulting Forester, Asheville
R. B. Robertson, President, Champion Fibre Company, Canton

South Carolina

H. A. Smith, State Forester, Columbia
H. L. Tilghman, Tilghman Lumber Company, Marion

Tennessee

J. O. Hazard, State Forester, Nashville
S. F. Horn, Editor, Southern Lumberman, Nashville

Virginia

J. A. Burruss, President, Va. Polytechnic Institute, Blacksburg
P. R. Camp, Camp Manufacturing Company, Franklin
J. P. Hummel, President, Hummel-Ross Fibre Corporation, Hopewell
Chapin Jones, Director of Education, State Forester Serv., Charlottsville
W. D. Tyler, Vice President, Clinchfield Coal Corporation, Dante

West Virginia

T. H. Clagett, Chief Engineer, Pocahontas Coal & Coke Co., Bluefield
John Raine, President, Meadow River Lumber Company, Rainelle
B. L. Roberts, Cherry River Boom and Lumber Company, Richwood

FOURTEENTH ANNUAL REPORT AND PROGRAM

APPALACHIAN FOREST EXPERIMENT STATION

ASHEVILLE, N. C.

SUMMARY OF ACTIVITIES FOR THE FISCAL YEAR ENDING JUNE 30, 1935.

For the past fourteen years the Appalachian Station has been working chiefly upon problems arising in the different aspects of forest management, in a region in which management generally means the rehabilitation of depleted forest and other uncultivated lands. Thus when the various programs aimed at comprehensive social and economic betterment through land-use planning were recently launched, the Station was in a position to furnish some immediate assistance and, without material change in plans or organization, to acquire needed additional information.

While Federal agencies have repeatedly in the past called attention to the need for improvement of local living and working conditions of rural communities, it has only been during the past two or three years that any definite steps have been taken toward this end. A marginal land problem of vast proportions, in which forestry enters as an essential factor, has passed from a theoretical to an active working stage. In this transition the Southern Appalachian and adjacent Piedmont and Coastal Plain regions have acquired prominence, partly because of the selection of the Tennessee Valley as the scene of the first large-scale development project, partly through the material increase in national forest land, with its promise of permanent improvement in the living conditions of local communities, and partly because of the intensive activities of the Soil Conservation Service within this territory. Throughout the region, locally exhausted forest resources and locally run-down, abandoned, and eroding crop-lands have reduced means of livelihood and lowered the morale of the population.

The measures taken to relieve these conditions are closely associated with the emergency relief employment activities, all constituting the present phase of the rehabilitation program. The Appalachian Station continued during the past year to furnish work (ECW, FERA and Nira) to a relatively large number of persons. These were employed on studies aimed to provide information useful in the land-use and related activities, or on construction projects to facilitate such studies.

Practically all the Station's work contributes fundamentally to the urgent needs of the rehabilitation program, but some of the projects have been expanded or otherwise modified, better to meet the immediate requirements. In the field of forest management, for example, while the regular project made available much needed data on the growth rate of Appalachian hardwoods, the work was extended to provide special information on selective cutting, for use in connection with the conservation provisions of the Lumber Code. Similarly in the study of streamflow and erosion, the best treatment for marginal forest and agricultural lands - an essential object of the regular investigation - is also the central problem of land-use planning, to which the regular study is contributing in many ways. The

(Over)

investigation of forest management on the Coastal Plain was extended to include a special study of the growth and utilization of loblolly pine for pulpwood, in order to meet the growing demands for information arising from the prospect of a Coastal Plain expansion in paper manufacture.

To disseminate the information thus obtained so that it would be available for use in the rehabilitation program, a series of brief "technical notes" was issued.

The size of the relief personnel made available for this work greatly increased the Station's capacities and permitted the accomplishment of tasks that would not otherwise have been possible. Crews from CCC camps were employed on each of the Station's four experimental forests, on the streamflow-erosion area in the "Copper Basin" in Tennessee, and elsewhere. Additional technical personnel employed under the Nira as well as the ECW allotments assisted in the investigative field work, and still others were employed as office assistants, compiling and computing the data. The FERA supplied other field labor and office help.

Specifically, in the streamflow-erosion study emergency labor from CCC camps, under the immediate direction of technical assistants, installed approximately 26 weirs, equipped with self-recording apparatus, on small streams in three experimental areas. These were matched by self-registering and other instruments to record precipitation, and a considerable amount of additional work was done by the emergency crews in the installation of miscellaneous experiments - in road-bank planting, measurement of the interception of precipitation by tree-crowns, and the like.

Civilian Conservation Corps crews and other ECW employees functioned very satisfactorily in the establishment of 1/5 acre growth-study sample plots on three of the experimental forests, completing a series aggregating 2,670 of such plots. Forest type and topographic maps of two experimental forests, made by emergency employees under the direction of a permanent member of the staff, were completed during the year. CCC crews and other emergency employees assisted materially in the establishment of permanent selective cutting plots, the establishment of controlled burning of fire study plots, and in plot establishment and tree and cordwood measurements in the Coastal Plain pulpwood study. In fact, there was hardly any part of the Station's field and office work which did not receive substantial help from emergency sources.

As a result of the emergency employment provided for public works during the depression, much has been done on the Station's four experimental forests to facilitate the investigative work. The physical improvements consisted mainly of the erection of small laboratories, work-shops, bunk-houses, and garages, provision of water supplies, light and power connections, construction of roads and trails, and reduction of fire hazard. During the fiscal year 1935 the following construction items were added:

On the Bent Creek Experimental Forest (Pisgah National Forest, North Carolina), there were constructed 1 3/4 miles of ridge road, for protective purposes, and 1 1/2 miles of cross-road, for utilization and protection. A 4-mile stretch of previously existing road was widened preparatory to surfacing. All of the work was done by CCC crews.

On the Toccoa Experimental Forest (Cherokee National Forest, North Georgia), 5 miles of general purpose road within the area and 7 miles of approach road from existing highways were built, with CCC labor. Nine miles of graded foot-trails were completed with Nira labor, together with 2 miles of subsidiary and special purpose trail, constructed by CCC crews. CCC crews also made a fire line around the new forest boundary. The dwelling, bunkhouse, spring house, and cook's house were completed, using Nira labor,

On the Fernow Experimental Forest (Monongahela National Forest, West Virginia), ECW personnel was used in completing a topographic map and in maintenance of fire breaks. An FERA crew, averaging 40 men, was employed in building a stone base for 2 1/2 miles of road and in maintaining other roads, trails and ditches. The dwelling, laboratory, combined workshop and garage, and deep-well electrical pumping system were completed with Nira labor. It is of interest that the city of Parsons, West Virginia, has built a dam on the area providing a gravity water supply system for the city in place of the previous pumping system.

On the Coweeta Experimental Forest (Nantahala National Forest, North Carolina), physical improvements include 4 miles of entrance roads and telephone line, and 20 miles of foot-trails. Three buildings on the area finished during the past year have been occupied by field parties continuously since their completion. A base and topographic map, together with a forest type and condition class map for the area has been completed for use in both management and influence studies.

A new CCC camp, F-23, to be manned in July, 1935 is now nearing completion and will be used for further development of the Coweeta Forest, both for necessary roads, trails, and fire breaks, and for installations and investigations.

Camps for CCC are also in course of construction for occupation in 1935 for work on the Toccoa and Bent Creek Experimental Forests, and it is expected that much assistance will be afforded by nearby camps on the Fernow Experimental Forest in West Virginia.

Steps have been taken to find and include within new experimental forests certain important forest types and conditions that do not occur within the present areas. Among the types and conditions sought were (a) loblolly pine of different age-classes and degrees of stocking; (b) coastal hardwoods; (c) even-aged upland hardwood stands typical of those that have followed clear-cutting for charcoal wood over extensive areas in the northern part of the Station's territory; (d) forests typical of the farm woodlands, characteristic of the Piedmont and other plateaus; (e) old-growth hardwood stands in the mountain region; and, (f) spruce stands in different stages of reproducing. The search was successful in locating areas representing, in some measure, all these conditions. A coastal area of loblolly pine, with a small body of bottomland hardwoods, was tentatively selected on the Wambaw division of the Sumter National Forest, near Charleston, South Carolina. Another promising area of loblolly pine type was found on the Croatan Purchase Unit, near New Bern, North Carolina.

On Three-Mile Mountain, near Edinburg, Virginia (George Washington National Forest), a promising combination of second-growth stands of different types and conditions was found, the greater part consisting of hardwoods following coaling operations. An area presenting good investigative possibilities in connection with old and second-growth hardwoods, and cut-over, but unburned Spruce forest, was discovered at the head waters of Williams River, on land recently acquired for the southern extension of the Monongahela National Forest, in West Virginia. Formal action to set aside a number of these areas as experimental forests will be taken in the near future.

An addition of 1600 acres to the Toccoa Experimental Forest has been recommended. A recent acquisition by the Forest Service permits this addition, which will give the Toccoa Experimental Forest an entire watershed of 3,900 acres. A similar addition to the Bent Creek Experimental Forest is being considered, the result of which will be to place the entire Bent Creek valley within the experimental forest except for areas reserved for recreation sites. The area under consideration is about 4,800 acres. Final recommendations for this addition have been deferred pending decision as to a link of the Park-to-Park Highway, alternate routes for which are through and adjacent to the experimental forest.

A shortage of furniture at the experimental forest headquarters was remedied, in part at least, by a liberal donation from the Veterans Hospital at Oteen, N. C.

Cooperation between the Station and Regions 7 and 8 of the Forest Service was advanced by an informal investigative meeting attended by representatives of the three agencies at Asheville, March 25 and 26. Twenty-nine were in attendance, including the two Regional Foresters, forest supervisors, and other members of the headquarters and field administrative forces, and the staff of the Appalachian Forest Experiment Station. Lively discussions of the several investigative projects from the administrative and research points of view led to the formulation of agreements for the conduct of future cooperative work. Among these was a decision to hold a meeting each year at which progress and plans for investigative work by the Station and Regions would be discussed.

FOREST MANAGEMENT INVESTIGATIONS

Mountain Forests

General:

During the current fiscal year the mountain forest management project of the Station has carried on considerable work of importance which is not definitely a part of the project plans. For example, a considerable portion of the personnel was involved in the inventory and mapping of types, condition classes and topography on three experimental forests. The work as originally planned has been about completed, but additions to two of the forests will require some more work of this nature in 1935.

A cooperative project was initiated with Region 8 for the preparation of volume tables. In addition to the construction of volume tables, research is being carried on to determine the feasibility of combining species in volume tables and the importance of site in affecting volume. Field data on felled trees are being collected by administrative men on the three national forests, and computations are progressing at the Experiment Station. Personnel engaged in this latter work include one man from the Experiment Station, one from the Pisgah National Forest and three SERA computers. It is planned to complete this work during the coming year - possibly by late summer or early fall.

Harvest Cuttings

Progress during the past year:

The Station cooperated with the Forest Products Laboratory and private timber land operators in the establishment of 4 selective logging areas. Cost-production studies were carried on to determine the costs of logging and milling under the various conditions existing on the two operations studied. A total area of 34 acres was involved in the 4 plots marked for selective cutting. Residual stands varied from 1300 to 2100 board feet per acre of merchantable trees, or from 11 to 22% of the volume before logging. This residual volume was concentrated largely in sound, low-profit trees of smaller diameter classes. When the analysis of the production costs is completed, it will be possible to make comparisons of the per acre profits under common logging practice and under the several degrees of cutting practiced on the plots.

Plans for future work:

These areas will be remeasured at intervals to determine the increment after logging, the adequacy of the new growth after logging, and the influence of the residual stand on the development of the new growth.

Preparations for continuing this type of work on a more intensive basis will be made during the coming year. The plans anticipate concentration of the project on experimental forests, particularly the Toccoa in North Georgia, where opportunities for making timber sales are increasing.

Cultural Methods

Progress during the past year:

Work on cultural methods has been limited to the routine remeasurement of existing plots and analysis of the data. These include the study of sprouting as correlated with the time of cutting, the reexamination of 32 cleaning plots in mixed hardwood new growth at Stony Fork on the Pisgah National Forest, the remeasurement of five white pine liberation plots on the Cherokee National Forest, and analysis of the 1933 remeasurement of the Looking Glass Rock cleaning plots which were established in cove hardwood new growth on the Pisgah National Forest in 1924.

The results of the cleaning made 10 years ago were apparent on the Looking Glass Rock plots in a greater number of desirable trees. There were 223 more desirable trees per acre on the cleaned plots than on the untreated, and the average increase in breast high diameter of desirable species for the 10 years was 1.67 inches for the treated and 1.40 inches for the untreated areas. The greater number of desirable stems per acre resulting from early cleanings points to the possibility of future profitable thinning on areas where markets are available for posts, pulpwood and other small dimension products.

Remeasurement of the Stony Fork cleaning plots at the end of the first growing season following treatment showed no significant difference in the height growth of treated as compared with check trees for the 1934 growing season. A similar result was observed for liberated white pine on the Cherokee National Forest for the first growing season after release. Just how long a period is required before a favorable reaction will follow treatment may be determined only by future examinations. This elapsed time is a matter of considerable importance because upon it depends whether or not the lower height trees fail to respond in sufficient time to outgrow the sprouts arising from the release cutting. If the released trees do not outgrow the sprouts, they may eventually suffer greater competition than if allowed to develop without treatment.

Plans for future work:

Work in cultural methods for 1935 will be directed toward the determination of the individual tree characteristics of a desirable crop tree. The proper degrees of release and spacing for various tree classes will be the objective of future work. A large portion of the effort in management research for the coming year will be devoted also to the establishment of experimental cleaning plots in the mountain region.

Reproduction Studies

Progress during the past year:

The major objective of this section of the management project is to determine the factors important in the germination and establishment of the reproduction of desirable species. While some of these factors are studied in other silvicultural projects, more thorough consideration is given to environmental factors in this section. A total of 64 quadrats have been established in the Bent Creek Experimental Forest and in North Georgia

to study seed-bed and other conditions influencing the germination and early survival of yellow poplar. Special treatments were given some areas. Among these were burning before the seed fall, soil scarification, and trenching.

The most favorable germination, survival, and growth, followed a winter logging which removed practically all overstory shade except a few yellow poplar seed trees. After the first two years, however, the germination was very poor, apparently because of the dense low shade of seedlings, sprouts, and herbaceous and shrubby vegetation which developed after logging. Germination on adjacent uncut areas with high shade but comparatively little low shade has been approximately the same for the entire 3 years since establishment of the quadrats. Aside from the yellow poplar seed tree cutting, there appeared to be very little difference in the annual mortality of forested as compared with open old field areas. In forested areas, however, the greater proportion of the annual mortality occurred during the winter months, while the mortality on open areas was greater during the summer.

In general, scarified areas both at Bent Creek and in North Georgia showed better germination than areas where the ground surface was undisturbed. This supports the general impression that logging is favorable to germination of certain species.

Further support of this contention was found in the work done on an area adjacent to the Bent Creek Experimental Forest, where the underbrush was removed in a mixed stand of shortleaf pine and oak second growth. In August, 1931, this area was ploughed to a depth of 4 inches, breaking up the root mat near the surface and exposing the mineral soil. The ploughing was roughly done, no effort being made to turn the furrows. On the area so treated, approximately 5 times as many seedlings germinated as on the untreated area.

Plans for future work:

Examination of these areas will continue, and additional areas on a more extensive scale will be established on experimental forests during the coming year.

Should adequate emergency funds become available, an extensive seed production study will be initiated. Several hundred seed traps will be built and established in each experimental forest to determine the frequency of seed years, the amount of seed produced, and the visibility of seed for various tree classes of the important species. The influence of biotic factors on seed crops will form a part of the study.

Growth Studies

Progress during the past year:

With the assistance of CCC crews from nearby camps, 2,670 permanent 1/5 acre growth plots were established last year on three experimental forests. The establishment of these plots was made a part of the inventory and mapping of the experimental forests and was thus accomplished with a minimum of expense. The data which will be obtained on these plots by periodic remeasurements will furnish an excellent basis for the determination of mortality and actual increment for a variety of forest types and condition classes.

Of particular interest will be the opportunity afforded to check various survey methods of growth determination on areas where actual growth is known.

The Experiment Station cooperated with Region 8 in the preparation of a working plan for the establishment of permanent growth plots in connection with the present timber surveys. It has been proposed that the project be carried on as an administrative study contributing to the work now under way by the Experiment Station.

A study of growth in partially cut stands was completed during the year. This work is of particular interest at the present time because of the recent importance placed on partial or selective cutting in Appalachian hardwoods. The procedure used was to search out unburned stands where partial cutting had been practiced in the past, and to sample the growth made by the trees left standing. Although the basic data are somewhat limited due to the scarcity of suitable stands, the study has resulted in a tentative method by which rough approximations of future volume can be made with a minimum of field work. Although additional data are needed before the method can be considered accurate for all Appalachian types and sites, the method in its present form will fill a definite present need.

Plans for future work:

The program of permanent growth-plot establishment will be carried out on new experimental forests and may be extended to include natural areas.

COASTAL FORESTS

The most important commercial species in the Mid-Atlantic Coastal Plain region is loblolly pine. Accordingly, all research work in this region has been concentrated on it.

Pulpwood Study

Progress during the past year:

The most important achievement during the past year was the initiation and completion of all field work on a study dealing with growth and production of loblolly pine pulpwood. The majority of the analysis work on this study has been completed. A new yield table for understocked stands has been developed, new volume tables for trees grown in old field and forest grown stands have been made, age has been isolated as the primary factor affecting amount of heartwood in individual trees, converting factors for stacked pulpwood have been determined and data on costs of harvesting pulpwood are being analyzed by the Forest Products Laboratory.

Plans for future work:

The completion of the analysis work on this study and the preparation of reports on the results are first in priority in the coming year's work. If funds are available, similar studies will be carried on for shortleaf and Virginia pines. If this work is done, the present plan of work will be modified to allow the preparation of a normal yield table for Virginia pine.

Germination and Early Survival of Loblolly Pine.

Progress during the past year:

Two technical notes were prepared (Nos. 6 and 7), One of these presented an improved method of cleaning loblolly pine seed and the other recommended moist cold storage as an improved mothod of storing loblolly pine seed over winter.

Samples of seed were collected from 200 carefully described trees and were subjected to cutting tests, germination tests, and have been planted in the nursery. Analysis of the data will allow for better definition of a seed tree. Field plantations of nursery stock will be made and followed in a one-parent heredity study. A study of effects of density of stocking in nursery beds was started.

Plans for future work:

In addition to the completion of work now under way and analysis of data already accumulated, a field study of factors affecting germination and survival is planned.

Other Sub-Projects.

Progress during the past year:

The only other work during the year was the reexamination of two sets of selectively logged plots.

Plans for future work:

The following work will be initiated as funds become available:

1. Establishment of a large number of semi-permanent growth plots, either as a part of the cruise of the experimental forest (when it is obtained) or as a separate project on national forest land.

2. Establishment of groups of methods of cutting plots on national forest land in cooperation with national forest personnel.

3. Establishment of groups of thinning, cleaning, pruning, and release

4. A study of the relations between soil conditions, growth of forest stands and the occurrence of shrubby and herbaceous vegetation.

FOREST FIRE STUDIES

Mountain Forests

Fire damage investigation continued to be the principal activity of the project during the past year, although a beginning was made in detection planning, fire weather, and fire behavior studies, for which working plans are being prepared.

Fire Damage

The principal objectives of the fire damage study are to develop methods for appraising damage and to discover the silvicultural significance of fire in the mountain hardwood stands.

Progress during the past year:

1. Establishment and experimental burning of the fourth of a series of large sample plots. A total of 3500 trees were tagged and described and more than 200 reproduction quadrats were established on the Toccoa Experimental Forest in north Georgia.

2. Analysis of growth and mortality following a fire in 1925 in a young stand of pitch and shortleaf pine on the Dent Creek Experimental Forest. It was found that over a ten year period: (a) the dominant group of trees was set back 10 years in growing time; (b) surviving trees on the burned area grew from 1/5 to 1/3 less in basal area than similar trees on the adjacent unburned area; (c) the degree of crown browning apparently does not influence mortality after the first two years; (d) growth of trees above 4 inches in diameter is significantly influenced by the extent of crown browning. Taking the 6 inch trees as an example, those with 60% of their crown browned had an average basal area increment half again as great as those 80% browned and twice as great as those 100% browned.

3. Examinations over a ten year period of a hardwood stand 2 to 14 inches in diameter which was burned in 1925 indicate that: (a) the total basal area of the stand during the first 5 year period was reduced by one-fifth and that during the second 5 year period, growth of surviving trees scarcely more than offset loss through mortality; (b) in the 4 to 7 inch diameter classes inclusive, the total basal area of the principal species -- white, black and scarlet oaks -- in the upper crown classes equaled the original amount only after 10 seasons of growth; (c) during the same time total basal areas of the lower crown classes decreased by 50%, and it is evident that for trees 8 inches in diameter, or less, any advantage derived from the trimming effect of the fire was nullified by mortality within the group; (d) considering only total basal area, there has been at least a 15 year loss in growing time as a result of the fire.

4. Adaptation of McCarthys curves to rating the intensity of forest fires in Appalachian hardwoods by 6 classes based on the percent of mortality in any diameter class. (Technical Note #8).

5. A cooperative investigation with the Pisgah National Forest on the elimination or reduction of dense growths of laurel and rhododendron to facilitate the establishment of reproduction of desirable species either by planting or by natural seeding. The national forest has established 3 series each containing 12 quarter-acre plots. In each series 2 plots were checked, and 10 plots were treated, of which 5 were planted with white pine and 5 left unplanted. All trees on planted plots were girdled. The treatments are: (a) grubbing and burning of all laurel and rhododendron; (b) cutting, piling and burning; (c) cutting, scattering and burning; (d) cutting 3 foot lanes at 8 foot intervals; and (e) clearing spots 3 feet in diameter at 8 foot intervals. The Experiment Station will be responsible for examinations and preparation of reports.

Plans for future work:

The establishment of another series of experimental burning plots, on the Fernow Experimental Forest; cooperative establishment of semi-permanent plots for the study of mortality, with national forests in the Station's territory; expansion of basal wounding study reported in Jour. Forestry 31;829-837, 1935.

Fire Weather and Fire Behavior

The principal objectives of the fire weather and fire behavior studies are to develop methods of predicting more accurately than can be done at present, the degree and periodicity of fire hazard, and the behavior of fire under different weather, topographic, fuel and cover conditions. Investigations to be carried on cooperatively with the U. S. Weather Bureau.

Progress during the past year:

1. Exploratory work in methods of measuring, and variations existing in moisture content of hardwood leaf litter. The basket method appears to be less reliable than hazard indication sticks in indicating moisture content of the upper leaf layer. Great differences exist between upper and lower layer of leaves. The upper cupped layer may have a moisture content of 8 to 12 percent, at which point it ignites readily, while at the same time, the lower layer may contain as high as 50 percent moisture.

2. Fourteen areas from .15 to .4 acres in size were burned during the spring fire season for the purpose of studying fire behavior. Although the areas were too small to yield much information on rate of increase of perimeter, it was obvious that wind velocity more than any other factor governed the rate of spread.

Plans for future work:

Experimental burning of a number of sizeable areas, provided a suitable location can be found, the principal purpose being a study of the factors influencing rate of perimeter increase.

Detection Planning.

The main objectives of the detection studies are to develop principles and methods of fire detection planning most applicable to mountain hardwood forests within the Station's territory. This involves range-of-visibility studies, selection of most practicable methods of visibility mapping, look-out performance, analysis of fire reports, and the use of visibility, fuel, and fire occurrence maps in detection planning.

Progress during the past year:

1. Photographic records of smoke produced by fires of known size. Fires of equal size produced very different amounts of smoke. For instance, visible smoke produced by a 6000 square foot fire one day was equivalent to that produced by a 1300 square foot fire on another day.

2. Smoke equivalent to 20 to 25 square feet of fire in hardwood leaves produced by bombs 800 feet below the line of sight, was scarcely visible from

a mountain top one mile away. This emphasizes again the importance of direct visibility if fires are to be discovered by lookouts when small.

3. A regular National Forest lookout on duty 3 miles from a series of experimental fires had an average discovery time of 8.3 minutes. The average size at time of discovery was 26 feet square.

Plans for future work:

Range of visibility and lookout performance studies; limited analysis of fire reports.

COASTAL FORESTS

The fact that 20 to 30 percent of the coastal pine forests burn over annually emphasizes the need for forest fire research in the region. Because of limited funds the only work done in the region to date has been the establishment and reexamination of two sets of controlled burning permanent sample plots and the collection of fire damage data on two sets of selective logging plots which burned over accidentally.

Progress during the past year:

Work during the past year has been limited to routine reexaminations and the preparation of a technical note on "The effect of a Light Fire on Loblolly Pine Reproduction."

Plans for future work:

Proposed future work, in the order of its priority, is as follows:

1. Extensive studies of mortality on areas burned over from one to four years before time of examination. All available information will be collected on each area studied, for the purpose of determining possible gross correlations of season of fire, time of day of fire, general meteorological factors, and stand density, age, and size, with mortality.

2. Extensive studies of effects of single fires on growth of trees and stands. Borings taken from trees on areas burned from 3 to 8 years prior to time of examination will be compared with borings from similar trees on adjacent similar unburned lands to determine the average loss in growth attributable to fires..

3. An extensive survey of present methods of presuppression and suppression, leading into researches on new methods. The compilation of information on present methods and costs may justify recommending a wider use of certain local practices. In addition, trials of methods offering promise, as well as of new methods (e.g., the development of permanent fire wells the use of light tractors on going fires, etc.) will be inaugurated in cooperation with existing private and public organizations.

4. Establishment of semi-permanent or permanent sample plots on areas burned over not more than two weeks prior to the time of work. Periodic observations will be taken to determine the progress of mortality and methods of estimating it.

5. Establishment of permanent sample plots to be burned over experimentally to obtain records under carefully controlled conditions on amount and progress of mortality and amount of loss in growth attributable to fire.

6. Establishment of groups of permanent sample plots in a study of the advantages and disadvantages of controlled burning as a protective measure in the loblolly pine type.

7. Establishment of fire weather stations and large numbers of experimentally burned semi-permanent plots to study factors affecting fire hazard and fire behavior. Data on rate of spread of fires will be correlated with meteorological data and observations on going accidental fires to establish scales of hazard rating and methods of predicting hazard. The plots will also be used to study mortality and losses in growth occasioned by fires of different intensities.

8. Tests of ignition points of different forest fuels, and of the heat equivalents of different kinds of common fire brands.

9. Study of detection, with particular emphasis on factors affecting radius of vision.

The work to be done during the coming year depends entirely on funds available.

STREAMFLOW-EROSION INVESTIGATIONS

Substantial progress in carrying out the Station's erosion streamflow investigation program was expedited in part by the availability of C.W.A. and C.C.C. labor which could be used advantageously for making major installations for watershed studies, and also in part by emergency funds that permitted the temporary employment of competent personnel, trained in soils, ecology, microbiology, and hydraulic engineering. The streamflow-erosion project has been carried prior to the past year as an orientation study, during which period areas were surveyed and selected for intensive study, and methods developed for watershed investigations. This preliminary study laid the foundations upon which it has been possible to take good advantage of emergency funds.

General Watershed Studies

Measure of vegetation control on unit watersheds

Progress during past year:

In the field of vegetation control twenty-six complete weir installations have now been established and continuous records of surface runoff from watershed supporting small streams have been obtained for periods of nine months to two years. These records of the behavior of small streams from watersheds under different kinds of vegetative control are now being analyzed for correlation with vegetative cover and other factors governing stream behavior. Inasmuch as cover conditions in the Southern Appalachian mountains are determined largely by past history and use of the land, the results obtained from the studies in progress are furnishing information basic to determining desireable management for the future.

Records to date indicate very decided differences in the rate and amount of storm flow and in the normal flow of small streams from watersheds supporting different types of vegetative cover. The maximum rate of runoff as flood flow per unit area of watershed may differ between forest cover and abandoned fields in a ratio of 1 to 25 or more, depending upon the type of storm.

Small plots have shown even more marked differences in surface stormflow due to changes in the humus type than have entire watersheds. For example, burning the litter under an old growth yellow-pine-hardwood forest increased the surface stormflow an average of ten times as compared to adjacent unburned control plots, in four storms of 0.75 to 1.00 inches total precipitation and with a maximum intensity of 0.25-0.50 inches for a twenty minute period. The same plots show a difference of 1 to 32 times for a single storm of the same total precipitation but where the maximum intensity reached 0.56 inches for a twenty minute period. In the latter storm, a plot from which the litter had been removed by raking for four years produced 160 times as much in surface storm flow as an adjacent plot on which the litter was undisturbed.

Progress was made in three directions:

(1) Major forest influence installation:

The Coweeta Experimental Forest has been established as a major forest influence investigational area. This area of 4,500 acres is located in the high rainfall belt of the Blue Ridge, five miles north of the Georgia State line, and within the boundary of the Nantahala National Forest of North Carolina. Investigational work to date includes the establishment of nine complete installations for the measurement of streamflow from the two larger streams of the area and seven smaller tributaries. Twenty-six rain gauge stations have also been established on the area.

(2) Copper Basin Forest Influence Studies:

Another important forest influence area has been established partly on and partly adjacent to the Cherokee National Forest in the smelter fume damaged locality of southeastern Tennessee, locally known as the Copper Basin. Originally this entire area within a 60-inch rainfall belt was controlled by a heavy hardwood forest. The area is unique in that it provides for a comparative runoff study of similar watersheds under forest cover, grass (broomsedge) cover, and complete denudation of all forms of vegetation. The denuded basis alone comprises some 8,000 acres, and is surrounded by a grass and shrub zone of about 12,000 acres, which in turn is surrounded by forest cover. The physiography of this area provides an exceptional opportunity for forest influence studies including the influence of plant cover on microclimate and on surface runoff and erosion.

A complete meteorological station has been established within each of the three vegetation zones mentioned, and two watersheds have been established and installed with settling basins and weir installations to obtain continuous records of runoff.

(3) Interception by Plant Canopies:

As a significant phase of the complete study of water economy of different watersheds within the region, an intensive study of the interception

of precipitation by forest canopies has been inaugurated on the Bent Creek Experimental Forest. Four plots two chain square have been selected, each representing a major forest cover type. Within each plot a battery of trough rain gauges has been placed to determine the actual amount of precipitation reaching the forest floor through the tree canopies. An intensity rain gauge placed in the open adjacent to the interception plots furnishes a control record of total amount of precipitation for the locality. All of the two to three hundred individual trees occurring on each plot have been equipped with a bole collar that collects all water coming to the ground along the tree boles. The water coming down the tree boles is collected by individual containers and measured after every storm. These measurements have been made continuously for the past nine months and will be continued for an additional eighteen months.

Plans for future work:

In the field of general watershed studies discussed in the proceeding paragrpahs, future work will include continuous records of streams from the twenty-six watersheds now under observation, together with further analysis of the vegetative cover, soil characteristics, and geology of individual drainage areas. The major forest influence installation on the Coweeta Experimental Forest will be further developed to the extent of making installations for recording stream behavior on each significant watershed supporting continuous runoff. Furthermore a number of additional installations will be made to record surface runoff from areas embracing a number of watersheds in order to synchronize the behavior of very small streams with the larger streams into which they flow.

Within the Copper Basin forest influence area, additional meterological stations are being established with a view to furnishing a further check on the influence of vegetation upon precipitation, evaporation, temperature, and stream behavior. Elsewhere within the region served by the Station, additional watershed studies will be inaugurated to supply further forest influence data for especially important land conditions not now represented.

Supplementary Studies in Absorption and percolation

Supplementary to general watershed studies, a number of investigations are in progress to determine the many factors that govern absorption and percolation of water into the soil. These studies are being carried out as a coordinated investigation into the nature and characteristics of the soil profile as it is influenced by different kinds of forest land use and misuse. A study in in progress of the manner in which a favorable soil structure for water absorption and percolation may be governed by organic additions to the soil surface through proper management of vegetation. This study is being approached from three angles: (1) a taxonomic study of humus types and soil profiles as influenced by forest land use, (2) a biological study of the organisms that control organic decomposition, and (3) an ecological study of plants and plant successions in relation to their control of the organic layers of the soil. In addition, attention has been given to the development of instruments and special apparatus as a part of the supplementary studies for this project.

Progress during the past year:

(1) Soil Studies:

The systematic study of the organic layers of the soil as they are

influenced by logging, fire, and land clearing has been carried out in both field and laboratory. This study includes an inquiry into the nature and function of the organic layers of the forest floor. It embraces the problems of litter decomposition and the effect of this decomposition upon the soil profile as a biologic entity. It also includes a study of soil structure and the factors that govern soil permeability, particularly organic material that comes to the soil through vegetation growth and decomposition. In addition to the commonly accepted ideas of the influence of organic material in inducing soil particle movement by swelling and shrinking and in developing lines of weakness along which soil shears when subjected to strain and stress, studies have indicated that organic matter acts in still another manner to influence soil structure, especially under forest cover. The organic matter in question is water soluble or in colloidal suspension. When water containing this substance penetrates the soil, it carries the organic matter with it. As the water evaporates or attains a film structure of near hygrosocopic thickness, organic matter comes out of solution or suspension and is deposited on the surfaces of soil grains and granules. For a while, after decomposition, the organic matter is somewhat sticky and unctuous to the feel and tends to hold soil particles together. After exposure to the air for some time, some of this organic matter is carbonized, loses its adhesiveness, and assumes a state which is highly resistant to decomposition processes. Groups of soil particles thus surrounded tend to become somewhat stabilized, and the granules, or flocculos, or little clumps of soil particles, thus "protected", tend to maintain their identities. Accordingly, when all of the soil has been broken up into granules due to strains, stresses, etc., already mentioned, and becomes protected with a thin film of organic matter, it assumes a granular structure.

In forests, the soil receives a new supply of soluble organic matter each year which is sufficient to maintain fungous and bacterial growths to various extents. The mycelia of the fungi grow downward along the cracks in the soil and thus increases the intensity of the lines of cleavage. Such growths may take place to a depth of several feet. Fungous growth also attacks the organic matter deposited in the surface soil in interstices and around soil particles, etc., and gradually "Insulates" the particles from each other with mycelia. In many instances mycelia growth becomes so dense and tenacious that it will hold a large amount of soil together in a clump which is not easily broken apart. As the mycelia die and disintegrate, spaces are left, so that in time a relatively large amount of pore space is formed. Thus, a forest soil becomes quite porous and well aerated and absorbs meteoric water readily. Of course, worms, insects, rodents, etc., aid in the creation of porosity in a forest soil, but the total effect of the former is believed to be greater than the latter.

(2) Microfauna of soil and litter:

The microfauna of the soil profile has been studied both by field observation and by laboratory analysis of samples from 34 locations representative of soil under different vegetative cover types. The microfauna has been extracted and analyzed. It has been observed that the soil has a distinctive fauna comprising some forty or more species of microarthropods that total 1,000 to 2,000 per square foot. Litter associated with broomsedge clumps shows a microfauna quite different from that of woodland litter. Comparison of the mineral horizons of old fields and forest soil profiles shows many species common to both. Mull litter is characterized by a smaller number of individuals (4,000 per sq. ft.), but the species are large, while a mor

litter has a greater number of individuals (9,000 per sq. ft.) of minute species. The mineral soil fauna under mull is quite distinct from that of mineral soil under mor. The chief effect of these organisms in the mineral horizons is to keep the soil open and channeled. The chief effect of the litter fauna is trituration of fungus digested litter together with the actual consumption of a certain quantity of fungus mycelium. The digestive tract of these microarthropods may be a desirable medium for cellulose decomposing bacteria in an environment which might otherwise be unfavorable.

(3) Plant successions on abandoned land:

Observations made during the past year indicate that very marked changes occur within the soil profile following different kinds of land-use, and that many of these changes are decidedly unfavorable to water absorption and percolation. In many instances of land clearing for agriculture and subsequent abandonment after a period of land exhaustive farming, the soil structure has become so completely broken down that it will undoubtedly require a definite program of restoration before it will become favorable for further plant growth.

These soils present an important problem of watershed rehabilitation, which must be attacked along broad fundamental lines. Inasmuch as many areas having depleted soils in the region are coming into public hands because private owners find them unprofitable to own, conservation agencies are becoming obliged to take charge of the management of this land. Adequate research is needed in the methods of handling this land so that progressive depletion of the soil will cease, it will no longer be a flood and erosion menance to adjacent areas, and some of its original fertility be restored

Analyses of vegetation on abandoned land have shown that some fields if left alone are unable to restock themselves, naturally, even in four to six years. Many exposed south and west slopes are progressively eroding instead of becoming restored by natural vegetation. Observations have shown that this condition is due to the fact that perennial vegetation cannot become established due to extreme drought conditions obtaining in exposed soil, and to the continued frost and sloughing action of the soil surface during winter months. It has been observed that shortleaf and scrub pine, black locust, persimmon, and sassafras, are much better able to establish themselves on depleted and eroding sites than other perennial vegetation. Studies are in progress to determine the most desirable procedures for better preparing unfavorable soils for tree establishment by use of fertilizers, shading and mulching to promote natural vegetation and improve moisture conditions.

(4) Instrumentation

An important part of forest influence studies is the development and adoption of instruments and apparatus for special purposes. This fact has been recognized in the assignment of one full time technician to instrument design and construction. Four completed pieces of apparatus have been made. The first is a silt sampler which operates by hand in small streams and furnishes an accurate sample of stream water for determination of silt load. The second is a simple device for recording sunshine duration. The third is a recording device for wind direction. The fourth is an accurate hook gauge

of small size for measurement of slight amounts of evaporation from open water surfaces. Present plans include the development of automatic instruments for taking silt samples from small streams. Also the simplification of meterorological instruments by coordinating a number of significant records upon a single record chart.

Plans for future work:

Future work under supplementary studies on absorption and percolation will be directed toward the coordinating of the characteristics of the soil profile with the nature and conditions of the vegetative cover. Further studies include an intensive analysis of the soil profile, absorption, and percolation under virgin soil of a Piedmont forest, as compared with the successive transition cover conditions that have resulted from man's exploitation of the original forest land.

Future supplementary studies include the construction and operation of several sets of lysimeters, designed to furnish further data on water losses from soil surfaces by evaporation, and water losses occasioned by the water requirements of plants.

Watershed Improvement

Progress during the past year:

Practical erosion control studies have included methods of sloping and holding loose soil on road cuts and fills, and of establishing vegetation on road banks and other exposed soil particularly unfavorable to plant growth. Some of the results of these studies have appeared as technical note #12 of the Station. The Station has cooperated with the Nantahala National Forest in the north Georgia Mountains in testing out twelve miles of road bank control, largely through wattle construction. Three miles of road bank tests have been made in the Pisgah National Forest. Additional planting tests have been made with stem and root cuttings of black locust, willow and hybrid poplar.

A number of tests have also been made of direct seeding on abandoned land, using shortleaf, pitch, loblolly,and white pine, and black locust. Seedings have been made with seed stratified to promote maximum and uniform germination, and seeded late enough in the spring to avoid destruction by rodents and migrating bird flocks. Some success is indicated where the seed bed has been prepared by plowing or by the removal of sod in seed spots.

Plans for future work:

In the field of watershed improvement, the Station will concern itself with understocked or mismanaged forest lands that present a special problem of unfavorable storm flow relations; and with wild and abandoned lands which, although once cleared for agriculture, are no longer used for cultivation because of their present impoverished or eroded condition. Insomuch as a large quantity of such land is now coming under National Forest ownership, the Station is called upon to assist in developing methods for eliminating as soon as possible the flood and erosion menace which these lands create. The entire approach to this problem will be through the rehabilitation and restoration of these lands through forests and forestry practices. This will include the testing out of methods to favor natural regeneration when seed

trees are available, and methods of direct seeding or planting where seed trees are not present. It will also include methods of watershed improvement by land treatment or by encouraging natural herbaceous vegetation where such a cover is desirable for purposes of obtaining an immediate vegetative protection. This investigation will be carried out largely within the Piedmont of North and South Carolina.

FOREST PLANTING STUDIES

Progress during the past year:

Funds available to the Station for planting studies are entirely inadequate to meet the needs of a constantly increasing volume of forest planting in the region either as silvicultural practice or for streamflow regulation and erosion control. The following work was done during the past year, incidental to the mountain forest management project:

1. The usual remeasurement at the end of the growing season was made of three planted white pine sample plots (Plots 17, 18 & 19) at the Georgia Mountain Experiment Station. These plots were established in 1931 to test different spacings and different grades of planting stock. A cleaning was made in Plots 17 and 18 which are old-field plantations. No treatment was given Plot 19, an underplanting. An establishment and progress report was completed for these plots.

2. A plantation of 3,000 one-year-old Black Locust seedlings was made in April, 1935, on the Toccoa Experimental Forest, occupying a slightly eroding old field at 2000 feet elevation. Four 1/4 acre plots were planted, two spaced 4 x 4 feet, and two 6 x 6 feet. An establishment report was prepared.

3. On the Toccoa Forest, 500 cuttings of hybrids of the genus Populus were planted in 1935 -- 50 cuttings of each of 10 varieties. Equal numbers of each variety were planted on six planting sites, and an establishment report was prepared.

Plans for future work:

The regular examinations of established plantations will be continued. Further work on this project is dependent upon whether or not additional funds become available for it.

INVESTIGATIONS IN FOREST PATHOLOGY

(Division of Forest Pathology, Bureau of Plant Industry, in Cooperation with Appalachian Forest Experiment Station)

Pathology research has been carried on during the past year largely with ECW funds. The object of this work has been to try to answer some of the pertinent questions involving diseases that have arisen as a result of the ECW timber stand improvement program. The first three projects listed are of this nature. Since the regular work of the Division of Forest Pathology in the Appalachians was eliminated by economy provisions several years ago, no long-time projects have been initiated.

Decay factors in sprout hardwoods

Progress during the past year

This project has been carried on entirely in northern and central Virginia. One-fifth acre plots in young sprout oak have been cut clean and the amount and origin of decay studied. The effect of fire-scarring was eliminated from the problem by choosing areas in which the trees were not scarred. To date about 1,500 trees have been dissected. Twenty-six percent of them have had some butt rot. The average height of decay in the decayed trees has been about 42 inches. The origin of all but a small proportion of this decay has been the parent stump. Some of the factors affecting the decay hazard in stump sprouts are height of origin of the sprout on the stump, height and diameter of parent stump, number of sprouts on the parent stump, and tree species. The work so far has indicated that a definite decay hazard exists in sprout oak timber resulting from repeated cutting on short rotation, and that measures taken to favor seedlings, sprouts from small stumps, and sprouts arising close to the ground will reduce incidence of decay.

Some of the results of this work have been reported in a mimeographed release entitled "Supplementary Information on Forest Tree Diseases in Relation to Stand Improvement".

Plans for future work:

If funds become available similar work will be carried on in the Southern Appalachians and on the Monongahela National Forest.

Nectria canker of hardwoods

Three phases of this problem are under investigation: (1) to determine whether one or more than one strain or species of Nectria is involved in the cankers on various tree species; (2) to determine whether felling or girdling trees with Nectria cankers is the best control measure; (3) to investigate the possible relationship between tree vigor and susceptibility to Nectria canker.

Progress during the year:

In the first phase (study of strains) about 2,500 cross inoculations have been made, testing the pathogenicity of Nectrias from several species of hardwoods. The work to date has indicated that at least two and probably more forms or species of Nectria are involved in canker formation on hardwoods in this region. The form that attacks yellow poplar has been constantly associated with cankers on that species and seems to occur only on that species and on mountain magnolia. Another form appears to attach a wide variety of hardwoods.

The study of control measures (felling vs. girdling) was carried on with about 200 cankers on black walnut in West Virginia, and 200 cankers on yellow poplar in North Carolina. The criterion of effectiveness is the amount of subsequent fruiting of Nectria after felling or girdling. There has been more subsequent fruiting on felled cankered trees than on girdled.

The difference was not great enough, however, to recommend girdling over felling where other considerations dictate felling as more desirable.

In the investigation of the third phase (tree vigor and susceptibility), artificial inoculations indicate that suppressed trees are more susceptible to severe canker infection than are trees of superior dominance. This relationship to vigor is most striking in yellow poplar. Several plots of tagged cankered trees have been laid out in order to observe canker development on trees of varying dominance.

Some of the results of the Nectria work have been reported in a mimeographed release entitled "Information on Nectria canker diseases in relation to stand improvement".

Plans for future work:

If funds become available some phases of the cross-inoculation work will be continued. The pathogenicity of new isolates will be tested, and the capacity of some forms to produce cankers on different species will be more closely investigated.

Strumella canker of hardwoods

Progress during the year:

Observations were made on Strumella cross-inoculations put in in 1933 on oaks in northern Virginia. Strumella coryneoidea, regarded as the cause of this canker, was obtained from various species of oak and inoculated on the species from which the specimens were taken and on several additional species. The object is to test the pathogenicity of forms of this fungus on oak to try to determine whether or not it really is the cause of the canker attributed to it. At the time observations were made this year no lesions had been formed, and the inoculation wounds appeared to have quite completely healed over.

Plans for future work:

The inoculated trees will be observed at intervals for possible canker development. If funds are made available more inoculations will be made using new isolations, and they will be made at different times of the year in different locations.

Blue-stain in peeled pine pulpwood

Progress during the year:

This project was run in connection with the Coastal and Piedmont pine pulpwood studies of the Experiment Station. Observations were made on the rapidity and extent of blue-stain in several hundred peeled bolts of loblolly pine in the Coastal Plain of South Carolina and in a similar number of bolts of shortleaf pine in the Piedmont of North Carolina. The extent of internal stain was determined by splitting 10 percent of the bolts each time observations were made. At the end of 1-1/2 months 41 percent of the sapwood volume of the shortleaf and 28 percent of the sapwood volume of the loblolly was stained. Later observations showed practically no increase in amount of stain beyond 1-1/2 months. The different types of penning had no effect on the amount of stain. The proportion of sapwood stained increased with bolt

diameter. The proportion of stained wood in the different layers in the pens was almost the same. Inside and outside bolts had about the same proportion of stained wood. Machine-peeled wood had significantly less stain than hand-peeled wood. In a preliminary chemical treatment test one pen of wood was treated with one of the more efficient proprietary compounds used against blue-stain in lumber. No stain at all developed in the pen so treated. The results of the work to date will be issued as a Technical Note.

Plans for future work:

Any future work on the problem of stain in pulpwood depends on whether or not stain is considered objectionable in the manufacture of those kinds of paper made or to be made from southern pine. Work on this latter question is in progress elsewhere.

Cull in Appalachian Hardwoods

Progress during the year:

The data on about 8,000 trees in this region, taken over a period of several years on commercial logging operations, are being worked up. During the year three Technical Notes have been issued on this study. They are: Technical Note 3 - "Relation between Height of Decay and Tree Age in Certain Eastern Oaks", Technical Note 13 - "Relation between Tree Diameter and Percentage of Cull in some Eastern Hardwoods", and Technical Note 14 - "Relation between Butt Rot and Fire in some Eastern Hardwoods". In this work cull has been broken up into butt rot, top rot, and mechanical defect, and has been studied in relation to tree age, diameter, fire history, vigor, and geographical location.

Plans for future work:

Further analysis will be made of these data and the results will eventually be published in bulletin form by the Bureau of Plant Industry.

Service:

Progress during the year:

Visits were made to several of the national forests in this region in connection with the timber stand improvement work carried on by the CCC. The results of the ECW pathology research have been brought to the operating personnel in part by this means. Disease problems are gone over on the ground during these visits.

Plans for future work:

While some visits will be made to some of the older national forests most of the visits made during the coming year will be to new purchase units.

ENTOMOLOGICAL INVESTIGATIONS

(Division of Forest Insects, Bureau of Entomology and Plant Quarantine, in Cooperation with Appalachian Forest Experiment Station)

White grub investigation in forest nurseries

Progress during past year:

Data were collected from the chemical test plots at the State forest nurseries at Clayton, North Carolina; Camden and Georgetown, South Carolina. Some of these data reveal the harmful effects of arsenic when applied to the soil. In some cases where an amount of chemical insufficient to kill the grubs had been applied the seedlings were stunted and killed. Other chemicals such as napthalene, paradichlorobenzene, and carbon disulphide gave promise as being worth while in controlling white grubs.

Concentrated studies were started at the Georgetown nursery. Many experimental plots and seed beds were prepared, in some of which were placed repellent chemicals and in other stomach poisons. Various test beds for grub migration, host preference, and similar studies were established.

Hand in hand with the control work has gone the life history studies. Nightly beetle collections were made since the commencement of beetle flight in the spring. Weekly diggings have been made throughout the entire year in an effort to study the vertical migration of the grubs. Host preference studies under natural conditions have been carried on; and grub development studies have been made.

Plans for future work:

The investigations as given above will be continued. Because of the prolonged life cycles of some of the more inportant Phyllophaga species it will be necessary, in order to best learn how to control these pests, to continue the studies for a number of years.

Bark beetle and Bark beetle damage

Progress during past year:

Inspections were made of the pine timber stand-improvement work performed by the Civilian Conservation Corps throughout the territory covered by the Appalachian Forest Experiment Station. In these inspections data were collected as to the methods of timber cutting and means of slash disposal with regard to the effects such cuttings and disposals would have towards bark beetle attacks and the subsequent breeds.

In addition road surveys have been made over routes previously followed in an effort to spot new outbreaks of the southern pine beetle.

Plans for future work:

Follow-up inspections and road surveys will be made during the coming year.

Tree medication and wood preservation

Progress during past year:

Additions to the technic of chemical treatment of living and healthy pine trees have been made. In this development of technic hardwoods as well as conifers have been used in the tests. A large number of chemically treated trees have been used for demonstrative and test purposes.

Plans for future work:

Chemical preservation tests will be continued; especial efforts will be made to get relatively large amounts of promising preservative chemicals into the trees. For the most part only shortleaf pines will be used in the tests. Some of these trees will be left standing although the majority will be felled and sectioned. All treated trees will be used for test purposes and periodic examinations will be made of them.

Tests will be made to better the technic of chemical impregnation. Water amount and chemical amount tests will be run. In these experiments the amounts of water necessary to get thorough and practical distribution of given amounts of a chemical in a tree will be determined.

Bark beetle control by chemical measures:

Progress during past year:

Some tests were made on the control of bark beetle attacks by chemical measures. In a few cases spray tests were run. A number of injection tests were made. The ideal sought was a controlling chemical which could be applied to an attacked tree to kill the attacking insects without it being fatal to the tree. There have been indications that such a chemical could be found.

Plans for future work:

Both spray and injection tests will be made in an effort to find a chemical or combination of chemicals that will effectively kill the attacking bark beetle adults and their brood and, at the same time, try to save the tree from death.

Toxicity tests will be run. These tests will be attempts to obtain a toxic value as regards Ips and Dendroctonus for each and every chemical tried without considering the effects of these chemicals on the trees.

Water amount and chemical amount tests as given under "Tree Medication and Wood Preservation" can be likewise listed here.

Seasonal moisture variation in pines

Progress during past year:

The moisture variation sampling was changed from that employed during the seasons previous to this fiscal year. A change was made whereby the same trees instead of different ones are sampled each season. Only the mid-winter and mid-spring samples have thus far been made. Complete analyses of these results have not been completed.

Plans for future work:

It is planned to continue for the following four seasons similar moisture variation sample collections.

Dendroctonus frontalis plot studies and remeasurements

Progress during past year:

All the D. f. plots have been visited and cursorily examined; a few have been remeasured and carefully studied.

Plans for future work:

All the plots will be examined and the trees remeasured. All necessary notes as to conditions of such plots will be made. Some additional D. f. kills on the Bent Creek Experimental Forest will be plotted; the trees will be tagged and measured.

FIRE-WEATHER WORK IN SOUTHERN APPALACHIANS

(U. S. Weather Bureau in Cooperation with Appalachian Forest Experiment Station)

Progress during the past year:

The fire-weather work was continued much as in previous years. Essentially the same network of 18 stations was utilized, this number including several purely record stations; the same territory was covered; and forecasts were sent at Weather Bureau expense to the same addresses, which include all supervisory forest offices.

Forecasts were made and distributed during the 1934 autumn season from November 1 to December 7, and during the 1935 spring season from March 1 to May 6. They were furnished daily to local offices and distributed by radio and newspapers from Asheville; and were given complete distribution over the district on days of prevailing or anticipated fire hazard. The elements covered in the fire-weather forecasts included cloudiness, precipitation, wind and minimum humidity. The period covered was from the time of forecast release until the afternoon of the following day. When justified by settled weather conditions, the forecast period was extended another day, covering 3 days instead of two.

Probably the greatest problem of the fire-weather work of this district is that of effecting an adequate dissemination of the forecast information. During the last year, an attempt was made to improve the distribution of forecasts by having them broadcast from a network of 6 radio stations within the area covered. Results, for a number of reasons, did not come up to expectations, though they reached a wider hearing than formerly.

During the winter and spring months, the fire-weather official cooperated with the Appalachian Station in preliminary fire hazard and moisture determination studies, looking toward the possible development of a comprehensive program of fire-weather research. Such a program, if carried to completion,

would be of great benefit, not only to the forecasting work of the district but also to forestry work in general.

Work was done during the year on several fire-weather studies, one of which was completed and published in the August, 1934, issue of the Monthly Weather Review under the title, "Diurnal Variation in the Dewpoint Temperature at Asheville, N. C.". Due to the pressure of other duties, the other studies are not as yet completed. Most important of these is a comparison between temperatures and humidities on representative north and south slope sites, based upon hygrothermograph records kept at Bent Creek.

Plans for the next fiscal year:

To date the fire-weather service has been extended only to a rather limited area of mountainous country, within which are located the Pisgah, Nantahala, Cherokee and Unaka National Forests, and the Great Smoky Mountains National Park. However, plans are under way for extending the boundaries to include those portions of West Virginia and western Virginia which can be materially benefited. A sufficient number of definite station locations have been already made to serve as a preliminary network upon which to base the extension. It is planned to install these stations during the summer months of 1935.

The field for technical fire-weather studies and research is especially wide in this section, on account of the small amount that has been done here. During the next fiscal year it is planned to carry to completion as many studies as time will permit. The fire-weather official will endeavor to cooperate to the fullest extent with the Appalachian Station in research activities in which weather is an important factor.

INVESTIGATION IN FOREST BIOLOGY
(Bureau of Biological Survey in Cooperation with Appalachian Forest Experiment Station)

Progress during the past year:

Mr. T. D. Burleigh, the local representative of the Biological Survey, was called in to Washington early in the fiscal year to analyze and classify the collections so far made by him in this region. Later Mr. Burleigh was transferred to work at the Southern Forest Experiment Station.

Plans for future work:

No arrangements have as yet been made for the continuance of the biological work in the Appalachian region. In view of the number and importance of the biological problems relating to silviculture in this region it is urged that this cooperation be resumed as soon as possible.

ARTICLES PUBLISHED OR SUBMITTED FOR PUBLICATION

July, 1934 - June, 1935

(Not including prepared addresses)

Abell, C. A. — Results of 1924 cleanings of cove hardwoods Pisgah National Forest, Jour. Forestry 33 (6): 626-627, 1935.

Abell, M. S. — Use of the Craighead diameter tape for trees under 1.6 inches in diameter. Jour. Forestry 33 (1): 83, 1935.

Appalachian Forest Experiment Station — Forest improvement measures for the Southern Appalachians. U.S.D.A. Technical Bulletin 476.

Technical Notes as follows:

1. Ten years growth after a partial cutting in a mixed hardwood stand.
2. Growth of Appalachian hardwood forests.
4. Growth of Appalachian hardwood forests.
5. Site index curves for yellow poplar and white pine.
6. A suggestion for cleaning loblolly pine seed.
7. Storage of loblolly pine seed.
8. A method for rating forest fire intensity.
9. Effects of a light fire on loblolly pine reproduction.
10. Computations of national forest timber survey data: curve fitting and volume table checks and revisions.
12. Control of exposed soil on road banks.

Press releases as follows:

Hog hunts and golden dreams (Toccoa Experimental Forest).

Relief worker helps Uncle Sam.

Appalachian Forest Experiment Station (Cont'd)	Forest Fires that serve a purpose
	Life of the forest floor.
	David and Goliath in the forest (tree fungi).
Division of Forest Pathology, Bureau of Plant Industry	Supplementary information on forest tree diseases in relation to stand improvement. Mimeographed supplement to ECW Publication No. 2.
Frothingham, E. H.	Review of "The Practice of Silviculture," 3rd ed., by R. C. Hawley, Jour. Forestry 33 (4) : 442-443, 1935.
	Comments on "New Deal Forestry under Article X", by P. R. Camp. For.Jour. Forestry.
Hepting, G. H. and Hedgcock, G. C. (Division of Forest Pathology, B.P.I.)	Technical Notes as follows:
	3. Relation between height of decay and tree age in certain eastern oaks.
	13. Relation between tree diameter and percentage of cull in some eastern hardwoods.
	14. Relation of butt-rot to fire in some eastern hardwoods.
Hepting, G. H. and Blaisdell, D. (Division of Forest Pathology, B.P.I.)	A protective zone in red gum fire scars, Accepted by Phytopathology.
Hursh, C. R.	Soil moisture conditions of worn-out old fields should be improved to favor restoration by a tree rotation. Mimeographed.
	Vegetation in relation to soil and water. Mimeographed.
	Methods of planting exposed road banks for protection against erosion in the Southern Appalachians. Mimeographed.
Jacot, A. P.	Wild life of the forest carpet. Sci. Mo. 40: 425-430, May, 1935.
	Acarina as possible vectors of the Dutch elm disease. Jour.Econ.Ent. 27: 858-859, August, 1934.

Jacot, A. P. (Cont'd)	The species of Zetes (Oribatoidea-Acarina) of the northeastern United States. Jour. N.Y. Ent.Soc. 43; 51-95, March, 1935.
	Galumna alatus Willmann (Acari, Oribatidae). Ann. and Mag. of Nat. Hist. (Ser.10) 15: 489-492, April, 1935.
	Nothrus kornhuberi (Oribatoidea-Acarina) rediscovered through a grant of the Elizabeth Thompson Science Fund. Sci. Reports of Tohoku Imp. Univ.,Sendai, Japan. Fourth Series 10 (1): 1-3, April, 1935.
	Les Phthiracaridae de Karl Ludwig Koch. Accepted by Revue Swisse de Zoologie.
	Two species of lichen-mining mossmites. Ann. Ent. Soc. Am., 27: 462-467, Sept. 1934.
	The mite Oribata lamellata and related species. Records Australian Museum (Sydney) 19: 181-183, Sept. 1934.
	An intertidal mossmite in America. Jour. N.Y. Ent. Sec. 42: 329-336.
	A new four-horned mossmite (Oribatoidea-Acarina). Am. Midland Naturalist, 15: 706-712, Nov.,1934.
Lohman, M. L. (Division of Forest Pathology, B.P.I.)	A cultural and taxonomic study of Hysterium hyalinum. Papers Mich. Acad. Sci., Arts, & Letters, 19: 135-140, 1934.
	Lophiosphaera (Glomium) velata, with a critical study of its Septonema multiplex stage. Am. Jour.Bot. 21: 314-327, 1934.
MacKinney, A. L.	Some effects of three annual fires on growth of longleaf pine. Jour. Forestry 32 (8): 879-881, Nov., 1934.
McCarthy, E. F. and Sims, I. H.	The relation between tree size and mortality caused by fire in Southern Appalachian hardwoods, Jour. Forestry 33 (2): 155-157, 1935.
Nelson, R. M.	The effect of blue-stain fungi in southern pines attacked by bark beetles. Phytopathologische Zeitschrift 7: 327-353, 1934.
Nelson, R. M. and Sims, I. H.	Fire wounds have close relation to exterior discoloration. U.S.D.A. Yearbook, 1934. Pp. 218-220.

Pierce, L. T. (Weather Bureau)	The fire-weather service for the Southern Appalachian region. Mimeographed.
	Diurnal variation in the dewpoint temperature at Asheville, N.C. Mo. Weather Rev. August, 1934, pp. 289-293.
Shaw, Luther (Division of Forest Pathology, B.P.I.)	Studies on resistance of apple and other rosaceous plants to fire-blight. Jour.Agr. Res. 49.